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ABSTRACT

This instructional package, one in a series of individualized instructional units on automobile air conditioning, consists of a student guide and an instructor guide dealing with air conditioning charging. Covered in the module are checking the air conditioning system for leaks, checking and adding refrigerant oil as needed, evacuating the system, recharging the system with freon, and adding a partial charge to a system without a sight glass. The student guide contains an introduction, a list of procedures for completing the unit, an information sheet, and a posttest. Included in the instructor guide are an introduction, performance objectives, a list of references, suggested instructional materials, and an instructional script. (MN)

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INSTRUCTOR'S GUIDE

PROGRAM: AUTO MECHANICS **UNIT TITLE:** AIR CONDITIONING

MODULE TITLE: AIR CONDITIONER CHARGING **MODULE NO.** AM-83-310

INTRODUCTION:

The automotive air conditioner is almost standard equipment on most automobiles anymore. The skill to service the air conditioner is a valuable asset to the student who will soon be searching for employment. If you follow the procedures in this module and work safely, you should have no problem with the tasks involved. Mechanics can be a safe and enjoyable occupation.

PERFORMANCE OBJECTIVES:

After completing this module the student should be able to:

1. Check the air conditioning system for leaks.
2. Check and add refrigerant oil as needed.
3. Evacuate the system.
4. Recharge the system with freon.
5. Add a partial charge to a system with a sight glass.

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Learning Groups Designed For:

- ☒ Adult
☐ Special Needs
☒ Secondary
☒ Post Secondary

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CE037287

TEACHING/LEARNING RESOURCES:

1 Student Packet
1 Instructor's Guide, Key, and Script
1 35mm Slide Presentation
 Filmstrip

 Videocassette
 Film Loop
1 Audiocassette

Automotive Laboratory
Air Conditioner Service Tool Set
Vacuum Pump

Leak Detector
Supply of Refrigerant 12 (Freon)
Safety Goggles

INSTRUCTIONAL METHODS SUGGESTED:

This packet is designed for individualized instruction and adaptable for open entry/open exit programs. These materials can be used to supplement traditional instruction methods. Tests can be used for pretesting for advanced placement of students who are already competent in this area. Demonstrations by the instructor are recommended to enhance student learning.

REFERENCES:

1. Crouse, William H. and Anglin, Donald L., Automotive Air Conditioning, McGraw-Hill Book Co., 1977.
2. Factory service manuals as required.

AM-83-310 AIR CONDITIONER CHARGING - SCRIPT

1. This is a presentation of The Media Center, State Fair Community College, Sedalia, Missouri.
2. Air Conditioner Charging
3. Recharging the air conditioning system, following the step by step procedures in this module, will result in a finished job that performs the way it should, and will help to eliminate any comebacks.
4. Since there are a number of different air conditioning systems in use on the many makes of cars, it is important that you consult the service manual for any special instructions on the system you are working on.
5. Extremely high pressures, temperatures cold enough to freeze the skin, and poisonous gases are some of the hazards involved when servicing air conditioners, so pay particular attention to the safety precautions covered in this module.
6. After completing this module, you should be able to: (1) Check the air conditioning system for leaks.
7. (2) Check and add refrigerant oil as needed.
8. (3) Evacuate the system.
9. (4) Recharge the system with freon.
10. And, (5) Add a partial charge to a system with a sight glass.
11. To complete the tasks involved in this module you will need the following tools and equipment: manifold gauge set, freon can valve, vacuum pump, leak detector, thermometer or temperature tester, freon and safety goggles.
12. As the procedures for recharging the system vary depending on the reason for recharging and the type of system involved, let's start with recharging a system that has been opened, that is, one that is empty due to replacement of a part or hose.
13. Since the compressor must be lubricated, a quantity of oil circulates through the air conditioning system. A special moisture-free refrigerant oil is used for this purpose.
14. When a part is replaced, such as the condenser, or if the system suddenly loses pressure as when a hose bursts, a quantity of oil is lost and must be replaced before the air conditioner is charged.
15. Consult the service manual for the amount of oil to add to the system. In most cases the oil can be added directly to the unit being replaced.

16. If there is reason to believe that the compressor has lost some oil, the oil level can be checked on some models with a dipstick. Caution: Make sure the system empties of freon before attempting to make this check.
17. On some models there is no means of checking the compressor oil. If a loss of oil is suspected, the compressor must be drained and refilled with a specific quantity of oil.
18. After correcting for any loss of oil, you will be ready to proceed with the next step in recharging of the air conditioner.
19. Any air or moisture in the system must be removed as it could effect the operation of the air conditioner or cause serious damage to the compressor and other components.
20. This evacuation procedure is done with a vacuum pump specially designed for the purpose. A vacuum is applied to the system and the moisture is pumped out.
21. First the gauges must be hooked to the system. Hook the hose leading from the low pressure gauge to the fitting provided on the suction side of the air conditioner system. Screw the hose fitting on finger tight.
22. You can easily determine which is the low pressure or suction side as this hose runs only from the compressor to the evaporator.
23. Next hook up the hose leading from the high pressure gauge to the fitting on the high pressure line. This is the line that attaches to the condenser in front of the radiator.
24. The remaining hose on the gauge set is then screwed onto the vacuum fitting of the vacuum pump.
25. After plugging the vacuum pump into an electrical outlet, turn it on and open the valve.
26. Located on the gauge set in front of the high and low pressure gauges are valve handles which now should be opened by turning counter clockwise until they are fully opened.
27. Now watch the low pressure gauge which should now read at least 26 inches of vacuum. Allow the pump to run at least 20 minutes to fully remove all moisture from the system.
28. If the gauge will not read 26-29 inches of vacuum, you have a leak somewhere in the system. The method of finding the leak will be covered later in this module.
29. After the vacuum pump has run at least 20 minutes, close the valves on the gauge set and turn off the vacuum pump. The air conditioning system will now remain in a vacuum provided no leaks are present. Leave gauges in place for five minutes, then check. If the vacuum reading drops, a leak is indicated.

30. Before proceeding with the charging of the system, it must be determined how much freon is required to fill the system. The service manual contains this information.
31. The freon capacity is also printed on a tag attached to the compressor on many cars.
32. Now that you have determined how much freon is needed, put on your safety goggles and obtain a supply of freon and a freon can valve.
33. Open the can valve fully by turning it counter clockwise.
34. Clamp the freon can securely in the holder.
35. Now close the valve by turning the valve fully clockwise. This will puncture the can and at the same time, seal the flow of freon. Attach the other three cans of freon in the same manner.
36. Remove the hose from the vacuum pump and attach it to the fitting on the can valve.
37. Now open the can valve. If you are using a multiple can valve as shown open each valve.
38. Next slowly loosen the center hose fitting where it attaches to the gauge set until freon is heard to escape. Then tighten the fitting. This will purge all air from the center hose.
39. Now for a word of caution. Once the freon is hooked into the system, never open the valve on the high pressure side of the gauge set. This could cause the freon can to explode with great force.
40. You are now ready to charge the system with freon. Slowly open the valve on the low pressure gauge and allow the vacuum to pull the freon into the system. Hold the can upright to prevent liquid freon from entering which could damage the compressor.
41. When both gauges read 60-80 pounds, close the low pressure gauge valve. This is sufficient pressure to show any leaks in the system.
42. With a leak detector, check all parts of the system for leaks, drain the system and make repairs if needed and perform the evacuation procedure again.
43. Next, ensuring ventilation to remove exhaust gas and freon gas from the work area, start the engine and run at a fast idle and turn the air conditioner on maximum cooling.
44. Some systems use a low pressure switch which will not allow the compressor to operate when the system is low on freon. This switch must be bypassed with a jumper wire until the system is recharged.
45. Now you are ready to charge the system completely. Slowly open the low pressure valve on the gauge set allowing the freon gas to enter the system. Watch the low pressure gauge; don't allow the pressure to rise above 50 pounds.

46. If you have problems getting the freon into the system, you can place the freon container in warm water not over 120 degrees F. Never heat the cans with a torch or water hotter than 120 degrees.
47. When the correct amount of freon has entered the system close the low pressure valve on the gauge set and performance test the system. For a review of the performance test procedure, view the module titled Performance Testing and Manifold Gauge Pressure Diagnosis.
48. A slightly different charging procedure must be followed when recharging a system that is low on freon due to normal seepage which can occur over an extended period.
49. Vehicles with a sight glass located in the liquid line may be recharged by adding freon without discharging and evacuating the system first.
50. With engine running and air conditioner on maximum cooling, check the sight glass. If bubbles or foam appears in the sight glass, the system is low on freon and must have freon added until it is clear and no bubbles or foam can be seen.
51. When the sight glass is clear and sufficient cooling is taking place, stop the engine.
52. Now watch the sight glass. Bubbles should appear after about 45 seconds. If they do, the charge is sufficient. If no bubbles appear, the system is overcharged and some freon must be drained.
53. On systems with no sight glass, the system must be completely discharged, evacuated and recharged with the correct quantity of freon. Discharging the system is covered in the module titled, "Removing and Replacing Compressor Seal."
54. The following slides will summarize the procedures you have learned in this module.
55. You have learned two ways to add oil to compressors-
56. -and how to hook up a high pressure/low pressure gauge set to a system and use a vacuum pump to remove the moisture from the system-
57. You know how to determine the freon capacity of a system, connect freon cans into the system safely, and charge the system...
58. And check the system with a leak detector.
59. And finally, you ensure proper ventilation, then start the engine and performance-test the system.
60. (CREDITS)
61. (DISCLAIMER)
62. (REWIND)

STUDENT GUIDE

PROGRAM: Auto Mechanics **UNIT TITLE:** Air Conditioning
MODULE TITLE: Air Conditioner Charging **MODULE NO.** AM-83-310

PERFORMANCE OBJECTIVES:

Upon completion of this module you should be able to:

1. Check the air conditioning system for leaks.
2. Check and add refrigerant oil as needed.
3. Evacuate the system.
4. Recharge the system with freon.
5. Add a partial charge to a system with a sight glass.



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INTRODUCTION

The automotive air conditioner is almost standard equipment on most automobiles. The skill to service the air conditioner is a valuable asset to the student who will soon be searching for employment. If you follow the procedures in this module and work safely, you should have no problem with the tasks involved. Mechanics can be a safe and enjoyable occupation.

PROCEDURES

1. Read the objectives and introduction to this module.
2. If you feel you can fulfill 90 percent of the objectives, ask your instructor for the pre-test.
3. If you do not take the pre-test or do not meet the minimum requirements on the pre-test continue with the next procedure.
4. Study the information sheets which are part of this learning packet.
5. Observe and listen to slide/tape presentation Air Conditioner Charging.
6. For additional information, refer to the following sources:
Crouse, William H., Anglin, Donald L., Automotive Air Conditioning,
McGraw Hill Book Co., 1977.
Factory Service Manuals
7. Complete the activity sheets which are part of this learning packet.
8. Review the objectives to be sure you understand what you are expected to have learned. Performance of these objectives will be evaluated by your instructor.
9. Ask your instructor for the evaluation on this module.

INFORMATION SHEET

NOTES

Air conditioning service, repair and charging is as varied as the vehicles with air conditioning systems. Although the principles remain the same, the differences in the systems from one vehicle to another can be quite extensive. For this reason it is absolutely essential that the service manual be used in conjunction with this module.

The slide/tape presentation contains general information which applies to all systems regardless of the manufacturer.

Evacuation of the air conditioning system is a process of removing all moisture and refrigerant vapors from the system. Any moisture left in the air conditioning system when it is charged with refrigerant can affect the operation of the system and could cause serious damage to some of the system components. Moisture in the pressure controls or orifice tube in G. M. models can freeze and stop the flow of refrigerant which of course would result in the loss of cooling until the system is shut down and the ice melts. The combination of moisture, air and refrigerant in the system encourages corrosive chemicals to form which will damage the internal parts of the system components.

An air conditioning vacuum pump is used to remove the moisture and air from the system. If a low enough vacuum (at least 26 inches) is placed on the system, it will have the effect of lowering the boiling point of the moisture in the system where it will boil and vaporize at room temperature.

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The vacuum pump can then suck out these vapors. It normally takes about 20 minutes to fully evacuate the system.

Because of the problems that can be caused by moisture in the system, use only new refrigerant oil when it becomes necessary to add oil to the system, such as a compressor replacement. Refrigerant oil is a special moisture-free oil specially refined for this purpose.

The term refrigerant as used in this module refers to freon 12. This substance with a boiling point of -20°F makes an ideal refrigerant and is widely used in automotive air conditioners. Due to its extremely low boiling point, your body temperature is enough to cause it to boil violently with the resulting rapid loss of heat from the body surface the freon comes in contact with. It is easy to see why freon can cause serious injury should it contact the eyes or unprotected skin. So always wear eye protection and handle freon with care. Since very little heat is required to boil the freon, avoid placing the cans near any source of heat. The resulting boiling of the freon in the sealed container could build enough pressure for the can to explode with enough force to kill.

When charging the system with freon ensure that the freon container remains in the upright position so only freon vapor will enter the system. Some system

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components can be damaged if the system is charged with liquid freon. Insure that you have good ventilation when charging the system. Freon, normally a harmless gas, becomes very toxic when exposed to flame, as would occur when the vapors are pulled into the engine air intake and burned in the engine.

During the charging process, particularly nearing full charge, the pressures in the high pressure side of the system can rise to dangerous levels. Generally if the pressure rises near 250 P.S.I. stop the engine and place a fan in front of the radiator or spray a fine mist of water on the condenser. Should the pressure continue to rise when you resume the charging process, you most likely have a problem in the system which must be corrected.

As it would be a waste of time and freon to turn out a job as completed with a small leak somewhere in the system, testing for leaks is part of the charging procedure. Freon gas has no noticeable odor or color so special equipment is required to detect small leaks. Many times system leaks cannot be repaired with pressure in the system. So to prevent waste of freon the system is normally checked for leaks before a complete charge is put in the system. Normally 80 pounds pressure in the system is sufficient to check for leaks.

INFORMATION SHEET

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Ask your instructor for assistance on the use of the leak detector as there are a number of different types in use. In summary: Follow the procedures in this module and the service manual, work safely and you should have no problem charging the air conditioner.

ACTIVITY SHEET

I. AIR CONDITIONER CHARGING

- A. To complete this activity you will need the following tools and equipment.
 - 1. Air conditioner service tool set
 - 2. Manifold gauge set
 - 3. Vacuum pump
 - 4. Refrigerant oil
 - 5. Freon 12
 - 6. Safety goggles
- B. Secure from your instructor a vehicle in need of air conditioner evacuating and charging.
- C. Hook up vehicle exhaust system to shop exhaust removal system.

II. MANIFOLD GAUGE SET INSTALLATION

- A. Put on safety goggles.
- B. Fasten high pressure gauge hose from gauge set to high pressure fitting on system liquid line.
- C. Fasten low pressure gauge hose from gauge set to fitting provided on suction side of system.

III. EVACUATING SYSTEM

- A. Fasten center hose of gauge set to suction side of vacuum pump.
- B. Start vacuum pump.
- C. Open valves fully on high and low pressure gauges on manifold gauge set.
Note: Low pressure gauge should read at least 26 inches of vacuum.
- D. After 20 minutes close the valves on the gauge set.
- E. Turn off vacuum pump and disconnect gauge set hose from vacuum pump.

IV. CHARGING SYSTEM

- A. Consult service manual or tag on air conditioner compressor as to the quantity of refrigerant required to fill the system.
- B. Obtain required amount of refrigerant from your instructor.
- C. Install the refrigerant in the can tap valve. If you are not sure of the procedure, review the slide/tape presentation and ask your instructor for assistance.
Caution: As some refrigerant will be lost when tapping the cans, wear your safety goggles, make sure the area is well ventilated, and hold the can and valve assembly down and away from your face.
- D. Fasten the center hose of the gauge set to the can valve.
- E. Purge the air from the gauge set center hose.
- F. Open the can valve fully and both high and low pressure gauge valves.
- G. When pressure gauges remain constant, an indication that the system will not accept any more refrigerant, close both manifold gauge valves.

- H. Start the engine, turn the air conditioner on maximum cool.
- I. Slowly open the valve on the low pressure gauge.
Caution: Never open the high pressure gauge valve when the engine is running as high pressure refrigerant could enter the can, causing it to explode with tremendous force.
- J. When the required amount of refrigerant has entered the system, close both the gauge and can valves.

At this point, before removing the gauges from the system, ask your instructor to evaluate your work.

STUDENT EVALUATION
AIR CONDITIONER CHARGING

NOTE: Before taking this test as a posttest, you must have:

- a. Read and studied the supportive material in this module.
- b. Watched the slide/tape presentation "Air Conditioner Charging."
- c. Completed the activity sheet in this module.

UNACCEPTABLE SATISFACTORY EXCELLENT

I. SAFETY PROCEDURES

- A. Use safety goggles
- B. Engine exhaust ventilation
- C. Refrigerant safety

II. CHARGING PROCEDURES

- A. Gauge hook up
- B. Vacuum pump operation
- C. Use of freon can valve
- D. Charging system
- E. Leak test
